- A variety of different simple linear and log-log specifications, with different sets of variables, were considered to test the sensitivity of the results to variable inclusion issues (See Table 7-3 and the discussion below).

- Regressions using principle components of the quality variables were estimated to further address the multicollinearity issue.

Specific variable selection actions, as summarized in the specifications presented in Table 7-3 included:

- Ideally all survey defined quality variables (MQ variables in Table 7-l) would be included, but a preliminary regression with all variables found perfect or near perfect matrix singularity problems. Therefore the data set was reduced eliminating 3 selected MQ variables: MQAIR, MQFISH and MQWILD. In short, these were eliminated as, in the full sample, they had relatively low correlations with MQTREE (the variable whose coefficient is of interest) and high correlations with other MQ variables (and in most cases higher than the correlation of MQTREE with the other included variables). As a result we would expect this selection to have a relatively small impact on the estimated MQTREE coefficient, at least compared to the impacts on other MQ variable coefficients. Basic regressions with the housing distance and MQ variables are specified as regressions 1, 2, 7, 8 in Table 7-3.

- The researcher observed forest quality variables for large trees (PB) density (PB), and injury (V2,V3) are also correlated, in a generally decreasing order, with the MQTREE variable. It is possible that the survey respondent tree quality measure, MQTREE, is partially picking up size and density characteristics as much as injury characteristics. In addition, the visual injury scores (Vl,V2,V3) may be a useful alternative to measure MQTREE. To examine these effects, regressions 3 through 8 in Table 7-3, were estimated.

- Principle components were used to examine the affect of the selection and inclusion of the eight MQ site quality variables (Table 7-3 regression #13). The eight MQ variables were recombined into 8 principle components. Then a basic linear regression with housing characteristics, distance, PB, PF and MQTREE variables was rerun 9 times; 1.) with no principle components of the other quality variables, 2.) with only the first principle component, 3.) with the first two principle components, and so forth. Tracking the stability of the MQTREE coefficient and t-ratio with the inclusion of additional principle components indicates the severity of multicollinearity problems in the quality variables upon the MQTREE coefficient.

TABLE 7-3

Hedonic Property Value Analysis Regression Specifications

Specification	House Vars	Dist Vars	MQTREE	Other site Quality Vars,	V2/V3	PB	PF
Linear							
1	x	x	X	x(5)			
2	x	x	X	x(5)		X	X
3	x	x			X		
4	x	x			X	X	X
5	x	x		x(5)	X		
6	x	x		x(5)	X	X	X
7	x	x	X	x(5)	X		
8	x	x	X	x(5)	X	X	X
LOG-LOG							
9 (=l)	x	x	x	x(5)			
10 (=2)	x	x	x	x(5)		X	X
11 (=7)	x	x	x	x(5)	X		
12 (=8)	x	x	x	x(5)	X	X	X
13 (=3)	x	x	x	x(8)		X	X
2 STAGE							
14 (=1)	X[1]	X[2]	X[2]	x(5)[2]			
15 (=2)	X[1]	X[2]	X[2]	x(5)[2]		X[2]	X[2]
16 (=3)	X[1]	X[2]			X[2]		
17 (=4)	X[1]	X[2]			x[2]	X[2]	X[2]

[1] 1st step
[2] 2nd step
[3] number in parenthesis = = variables included

House variables = AREA, AREA**2, LOTSZ, FP, STR, S1, S2, S3, BR, RM BA P1, YB.

Distance varables = DTOWN, IDLAKE.

Other site quality variables = MQVIEW, MQLAKE, MQSTORE, MQSCHOOL, MQREC (FULL), and WEST data sets). MQVIEW, MQLAKE, MQSTORE, MQSCHOOL, MQAIR, (EAST data set).
Dependent Variable = PRICE.

Functional Form Issues

Linear regressions were used in moat specifications. However, non-linear specifications may be appropriate. For example, the linear specification assumes the value of a one unit forest quality change is the same for all housing types and all baseline levels of forest quality. This may be inappropriate. Alternatively, a change in forest quality may have the same percent change in the price of a home in the affected area, particularly because the average prices of homes in the WEST subsample is significantly higher than in the EAST subsample. Quadratic functions would not significantly assist on this problem as they would add more variables to the multicollinearity problem. Further the range of MQTREE values is small. As a first alternative, a log-log models (specifications #'s 9-12 in Table 7-3) were examined.

A second set of specifications (#'s 14-17 in Table 7-3) also received preliminary investigation. These specifications assume physical characteristics of the house are linearly additive to the base value of the house, and that distance and quality variables multiplicatively increase the value of the base house.

$$Price = (\{ ai*Hi) * (II\ Di^{bi}) * (II\ Qi^{ci})*el$$

where :

Price	= sale price
ai,bi,ci	= coefficients to be estimated.
Hi	= physical characteristics of the house such as square feet.
Di	= distance variables to key sites.
Qi	= variables representing environmental quality.

This form is intrinsically non-linear with too many variables to expect a significant improvement from most non-linear estimation packages. Ideally what we would desire to estimate is

$$Price/(\sum ai*Hi) = (\prod Di^{bi}) * (\prod Qi^{ci})*el$$

which is intrinsically linear, but cannot be estimated as the ai are unknown. However, at the expense of adding misspecification errors, the equation may be estimated in two intrinsically linear steps.

Step 1: Estimate $Price = \sum ai*Hi$

The omission of the distance and quality variables will potentially bias the coefficients of the included variables and reduce the significance of the reported coefficients. However, the correlation between the Hi variables and the Di and Qi variables is relatively small (Table 7-2) so the coefficient bias may be small for any individual coefficient and for all coefficients as a whole. Moreover, we are relatively less concerned with the coefficients and statistical significance of the included variables in the first step.

Step 2: Define $Price = \sum ai * Hi$

Estimate $(Price/Price) = (\prod Di^{bi}) * (\prod Qi^{ci})*el$

The coefficients in the second step will be biased to the degree that the corresponding variables are correlated with the Hi variables as a whole, which is relatively small. Due to the preliminary nature of this investigation with this specification, other error specifications may also exist and limit the reliability of the results.

7.4 Results

The results for the basic linear log-log specifications are summarized for the tree quality variables in Table 7-4. The detailed results can be summarized as follows:

- For all samples and regressions the R^2's are between .70 and .8O. The signs and magnitude on most all housing variable coefficient are as expected. Sample regressions for the FULL SAMPLE for regressions 1 through 8 are found in Tables 7A-7 through 7A-14.

- FULL SAMPLE. In the linear regressions l-8, the MQTREE coefficient is statistically significant and relatively robust to specification changes with values ranging from $3,700 to $4,200 for a one unit change in MQTREE. This represents a 4.5 to 5.0 percent change in the average housing price for a one unit change in MQTREE.

  The introduction of PB and PF only slightly reduce the MQTREE coefficient suggesting that these factors are only slightly being. incorporated into the MQTREE measure from the survey.

  The coefficients for V3 show a consistent expected pattern. The coefficient ranges from about $11,400 (Specifications 3,4) to about $4,500 - $5,800 when other site quality variables are included (specifications 5 and 6, which may be picking up some of the omitted MQTREE effects) and then again reducing to $2,000 to $4,000 and losing significance when MQTREE is also introduced (Specification 7 and 8). The $11,400 figure for V3, which would be used if there were no MQ variables, roughly corresponds to $4,600 per unit change in MQTREE when the scales are matched up (assuming V1 corresponds MQTREE = 4.5 and V3 corresponds to MQTREE = 2.0). The closeness of the estimates using only MQTREE or only V2 and V3 suggest that if MQTREE were not available from the survey, V3 could have served as a sat isfactory proxy, but the stability of the MQTREE coefficient and statistical significance, as compared to V3, suggest MQTREE may be a preferred measure in this sample.

  The results for the log-log specification parallel those in the linear specification, with a one unit change in MQTREE (from 3 to 4) resulting in a 5.3 percent change in average sale prices, although the percent decrease in value is declining as MQTREE increases.

TABLE 7-4
Sensitivity Tests on Variable Inclusion Using a Linear and Log-Log Specification

Regression Number and Description	Sample	Coefficients (t-ratios) MQTREE	V2	V3	R^2
Linear					
1. House + Dist + MQTREE +5 Qua1 vars	Full	4101 (2.71)			0.7490
	East	3722 (0.53)			0.7723
	West	14628 (2.92)			0.7656
2. House + MQTREE + 5 Qua1 vars + PB + PF	Full	3895 (2.40)			0.7493
	East	14278 (1.60)			0.7744
	West	15262 (2.97)			0.7655
3. House vars + V2, V3	Full		-982 (-0.45)	-9812 (-4.48)	0.7382
	East			-8071.38 (-4.22)	0.7639
	West		-10008 (-1.52)		0.7556
4. House + V2 + V3 + PB + PF	Full		-2567 (-1.13)	-11415 (-4.44)	0.7404
	East			-7740 (-3.69)	0.7719
	West		-10634 (-1.61)		0.7568

TABLE 7-4 (Continued)

Regression Number and Description	Sample	Coefficients (t-ratios) MQTREE	V2	V3	R^2
5. House + V2 +V3 + 5 Qua1 vars	Full		1689 (0.774)	-4509 (-1.77)	0.7481
	East			-4852 (-1.97)	0.7742
	West		-8793 (-1.337)		0.7614
6. Home + V2 + V3 + 5 Quality Variables + PB + PF	Full		184 (0.079)	-5858 (-2.03)	0.7489
	East			-5947 (2.34)	0.7760
	West		-8417 (-1.27)		0.7610
7. #1 + V2 + V3	Full	4185 (2.58)	3320 (1.47)	-2149 (-0.77	0.7497
	East	-673 (-0.73)		-6128 (-2.03)	0.7740
	West	15399 (3.063)	-10669 (-1.634)		0.7666
8. #2+ V2 + V3	Full	3752 (2.17)	1786 (0.74)	-3979 (-1.32)	0.7500
	East	3881 (0.36)		-5329 (-1.74)	0.7755
	West	15823. (3.07)	-9884. (-1.50)		0.7663
Log-Log (Equivalent linear version)					
9.(#l)	Full	.151 (2.51)			
10.(#2)	Full	.164 (2.62)			
11.(#7)	Full	.133 (2.10)	.012 (.06)	-.034 (-1.34)	
12.(#8)	Full	.108 (1.65)	-.025 (-1.05)	-.084 (-2.92)	

The incomplete principle components regression results are reported in Table 7.5. The table presents the estimated coefficient and t-ratio for the MQTREE variable for each regression as more and more of the components are included. Also reported is the percent of the variation of the MQ variables explained by the included components. For the full sample the MQTREE coefficient slowly increases as more components are added. It ranges from $2,300 when no components are included to $4,555 when all eight are added, with most estimates remaining statistically significant. From this we conclude that multicollinearity, or MQ variable selection, may be affecting the MQTREE coefficients estimate in the FULL sample, but not so significantly as to provide misleading results. (See also Figure 7-1).

- EAST SAMPLE. The coefficient for MQTREE in the linear specifications 1 through 8 is relatively unstable and statistically insignificant across the specification. The coefficient for V3 is statistically significant ranging between $4,700 and $7,700. This corresponds to about $1,900 to $3,100 per unit change in MQTREE, or about a 2.5 to 4.1 percent change in the price of the average house.

  The incomplete principle components analysis highlights the multicollinearity problem. When 5 or more of the components are included the collinearity is perfect or near perfect and the regression cannot be reliably estimated. However, the MQTREE coefficient for the inclusion of zero to 3 principle components, which explain between 0 and 84 percent of the variation in the MQ variables, is quite robust ranging from about $5,600 to $7,400, which is somewhat larger than for the FULL sample and suggesting the MQTREE measure is reliable once multicollinearity is accounted for.

- WEST SAMPLE. In the linear regressions 1 through 8, the MQTREE coefficient is extremely robust to the specification changes and statistically significant between values of about $14,600 and $15,800 per one unit change in MQTREE, or equalling 16 to 17 percent of the price of the average house.

  The coefficient for the proxy variable V2 (V3 could not be used due to limited observations where V3-1) is consistently between $8,400 to $10,600, which corresponds to $5,700 to $7,100 for a one unit change on the MQTREE scale (assuming V2 corresponds to MQTREE = 3), or between 6.1 and 7.6 percent of the average sale price. The statistical significance of these variables is weak.

TABLE 7-5

Incomplete Principle Components Analysis

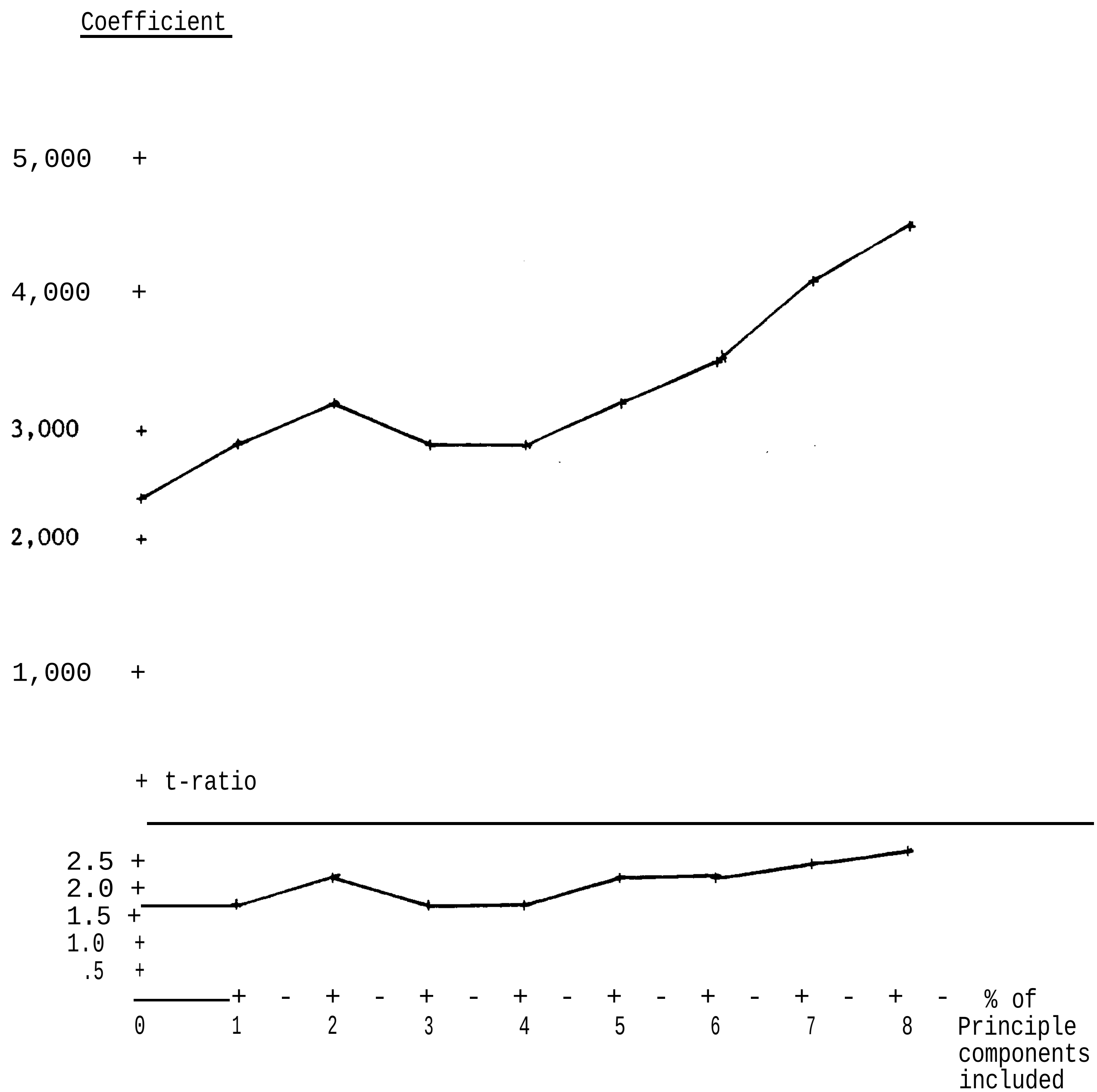
(Regression 13 Table 8.3)

SAMPLE and Statistic	# Principle Components Included 0	1	2	3	4	5	6	7	8
FULL SAMPLE									
1. MQTREE coefficient	2302	2902	3208	2707	2740	3395	3623	4150	4555
2. MQTREE T-ratio	1.61	1.875	2.10	1.77	1.79	2.10	2.26	2.51	2.75
3. % of MQ variables Explained by components included (Cumulative)	0.00	.55	.71	.84	.89	.94	.96	.99	1.00
EAST SAMPLE									
1. MQTREE coefficient	7308	7281	7437	5571	-7222	.9.2	9.2*	9.2*	9.2*
2. MQTREE T-ratio	3.81	3.75	2.97	2.08	-.06	0.00	0.00	0.00	0.00
3. % of MQ variables Explained by components included (Cumulative)	0.00	.47	.68	.84	.91	.97	1.00	1.00	1.00
WEST SAMPLE									
1. MQTREE coefficient	2077	5.00	-1226	7942	7556	3804	40317	40310	43380
2. MQTREE T-ratio	.82	0.00	-.03	1.76	1.56	.73	4.87	4.86	3.40
3. % of MQ variables Explained by components included (Cumulative)	0.00	.52	.74	.87	.93	.98	.99	1.00	1.00

l Non-fill rank matrices in estimation.

FIGURE 7-1

Trace of Coefficient on MQTREE
In Regression 13 When Using
PRMcycle Components of Other Quality Variables
(Full Sample-Linear Regression)



The incomplete principle components analysis suggest multicollinearity and MQ variable selection may be a significant problem in this sample. The MQTREE coefficient is not stable or statistically significant except for at around $7600 when the first 3 or 4 principle components are included. When most all components are included, and near perfect collinearity among the MQ variables occurs, the coefficient again stablizes at $40,000. This value is nearly 45 percent of the value of the average house and unsubstantiated by other evidence as being reasonable. We conclude the coefficient is unstable, but the analysis suggests the most plausible estimates in the range of $7,000.

Turning to the two step procedure, the results are summarized in Table 7-6. The results are highly consistent with the simple linear results in terms of the percent change in housing prices for a one unit change in MQTREE. They are also consistent with the log-log specification in indicating that the percent change in prices increases as the baseline level of MQTREE decreases.

SUMMARY

Examining the results across all data subsets and specifications indicate that tree quality may be significantly affecting property prices in the SBNF. Other conclusions from the results indicate:

1. The choice of functional form is much less significant than the choice of quality variables to include in the regression analysis when attempting to determine a reasonable estimate for tree quality variables.

2. The choice of variables to include, other than for the site quality variables, has limited impact on the estimate for the tree quality variable.

3. The MQTREE measure appears to include some other characteristics of the forest other than just injury, but this does not appear to be a significant limitation.

TABLE 7-6

Two-Step Procedure Results

Specification (Table 8-3)	Sample	Coefficient/(t-ratio)/% change*			F
		MQTREE	V2	V3	
15	Full	*.1807 (2.71) 4.3%			9.7
	West	.66 (2.4) 15.2			5.19
	East	.35 (1.0) 11.7			4.8
16	Full	.167 (2.4) 4.0%			8.6
	West	.65 (2.3) 15.0			4.4
	East	.95 (1.2) 21.9			4.2
17	Full		-.01 (-.44) .3%	-.097 (-4.05) 3.4%	8.9
	West		-.21 (-2.8) 12.7		12.4
	East			-.057 (2.7) 1.8	9.7

TABLE 7-6 (Continued)

Two-Step Procedure Results

Specification (Table 8-3)	Sample	Coefficient/(t-ratio)/% change			F
		MQTREE	V2	V3	
18	Full		-.05 (2.1) 3.5	-.15 (5.6) 5.4	9.9
	West		-.22 (-2.9) 13.3		8.5
	East			-.08 (3.4) 2.6	7.8

* % change calculated for a 1 unit change on the MQTREE scale. V2, V3 converted as discussed in text. Baseline MQTREE = 4.2, the sample average. Using MQTREE = 3 would increase results by a multiplicative factor of 4.3.

Using MQTREE > 5 would decrease results to .87 of those reported.

NOTE: All F statistics significant at the 1% level.

4. Either of the two alternative tree quality variables could have lead to reasonable and consistent results. The V2, V3 subjective rating, when converted to the MQTREE scale and used alone in the regressions (as if MQ variables had not been collected), give comparable results compared to those using MQTREE in the regressions and a judicious set of other MQ variables. However, the V2 and V3 variables are not as subject to multicollinearity problems as the MQTREE variable, but they are subject to critique of the researchers subjective judgments.

5. Our interpretation of the evidence suggests that forest wide the best estimate of a change of one unit in MQTREE ranges from $3,000 to $8,000, with a point estimate around $5,000. Based upon the incomplete principle component estimates, the values in the Big Bear and Lake Arrowhead/Lake Gregory area are not significantly different. Based upon the regressions with the V2/V3 variables, values for changes in tree quality may be slightly less in the Big Bear area than in the Lake Arrowhead region. Separate analyses were not done for other areas such as Forest Falls/Angeles Oaks, Wrightwood, etc. Based upon comparing the FULL sample regression results to those for the two subsamples suggest the values for these other areas may be less than in the studied subsamples.

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8.0 CONTINGENT VALUE DATA ANALYSIS AND FOREST DAMAGE ASSESSMENT

8.1 Analysis of the Contingent Value Responses

Table 8-1 provides summary statistics of CVM bids obtained in the recreator survey. Respondents' willingness to pay to avoid a l-step reduction in forest quality for 1) the Angeles and San Bernardino National Forests 2) all California forests and 3) all U.S. forests are shown. All three of these bid categories are incremental. The table shows means for all bids, means of positive bids and the percentage of respondents who bid 0. The strong effect that zero bids have on the overall mean is evident by the $10 to $13 dollar increase in the mean when zero bids are excluded. About one quarter of the respondents chose to bid $0.

Summary statistics for the property owners survey are presented in Table 8-2. Respondents willingness to pay to avoid a l-step reduction in forest quality for 1) areas around their residence, 2) the entire Angeles and San Bernardino National Forests, 3) all California forests and 4) all U.S. forests are shown. Again, all bids are incremental. Mean bids, mean of positive bids and the percentage of $0 responses are indicated. Like the recreator survey data in Table 1, the large number of zero bids has a strong effect' on the mean bids presented in this table. Zero bids account for 29.4% to 44.9% of the total bids in each of the willingness to pay categories. When zero bids are excluded, the value of the mean bids increases dramatically ($20-$29).

The large percentage of zero bids is consistant with the edit/anchor and adjustment model of cognitive psychology (which is discussed below). While some respondents may actually value the change in forest quality presented in the scenario as $0, psychology research shows that many respondents who bid $0 may in fact receive positive values from forest

TABLE 8-1 GROSS RECREATOR BIDS

	ANGELES AND SAN BERNARDINO N.F.		INCREMENTAL CALIFORNIA FORESTS		INCREMENTAL ALL U.S. FORESTS	
Mean	36.71	n=250	29.47	n=244	25.21	n=241
Mean (>0)	49.07	n=187	41.34	n=174	38.71	n=157
% Zero	23.9		23.8		26.9	

TABLE 8-2 GROSS PROPERTY OWNER BIDS

	NEIGHBORHOOD OF RESIDENCE IN ANGELES AND SBNF		INCREMENTAL ANGELES AND SAN BERNARDINO N.F.		INCREMENTAL CALIFORNIA FORESTS		INCREMENTAL ALL U.S. FORESTS,	
Mean	69.95	n=252	49.53	n=241	29.80	n=242	26.32	n=234
Mean (>0)	99.03	n=l78	75.07	n=159	51.15	n=141	47.74	n=l29
% Zero	29.4		34.0		41.7		44.9	

TABLE 8-3 RECREATOR BIDS FOR ANGELES AND SAN BERNARDINO NATIONAL FORESTS WITH SCENARIO REJECTION CHECK

	LOS ANGELES COUNTY	SAN BERNARDINO COUNTY	ORANGE COUNTY
Mean	46.56	35.87	50.38
Mean (>0)	52.12	40.50	54.72
Zero Bids/ Sample Size	8/75	8/70	5/63

quality but simply edit this attribute from their decision process. In other words, a very large number of factors "should" enter any decision such as where to recreate. However, given limited cognitive resources, people only consider the most important factors in any decision and edit the remaining factors. Editing of attributes apparently explains many of the zero bids obtained in contingent valuation studies. This phenomenon is discussed extensively in Gerking, McClelland, Schulze and Dickie (1987). To better understand the role of editing in generating zero bids, consistency checks were implemented.

Consistency Checks

One approach for eliminating suspect bids from the CVM is the use of answers to other questions obtained in the survey to cross check value responses. The application of such consistency checks was motivated both by the surprisingly large number of zero bids obtained in responses to contingent value questions as well as by the presence of very large bids, which, though typically smaller in number, have a disproportionate impact on the mean bid. Rowe and Chestnut pioneered the use of consistency checks and applied them extensively in their 1985 contingent value study of asthma. In later work (Rowe, et al., 1986 a and b) focusing on valuing risks from hazardous waste sites, extensive consistency checks were employed to insure that only credible bids were used. From these and other studies a general methodology has emerged.

The methodology was implemented in this analysis and can be described as follows :

First, cases in which the respondent refuses to bid or bids zero because the scenario is rejected should be identified and eliminated from the sample. Quest ion 22 of the recreator and question 36 of the property owners survey asks respondents if they would be willing to pay for management efforts to prevent air pollution from causing a decrease in the quality of the trees in all regions of the Angeles and San Bernardino National Forests. If respondents answered NO to the willingness to pay questions their reasons for bidding $0 were examined. The reasons were divided into the following nine categories where a decision was made as to their validity:

1. The polluters should pay.
2. I don't want to pay for management efforts; efforts are useless.
3. Taxes are already high enough.
4. Money is not the solution.
5. More controls are needed on polluters.
6. Need tougher auto emission standards.
7. Damage should be paid for by user fees.
8. I can't afford to pay.
9. Other (No Reason)

Only respondents who bid zero because they felt that taxes were already high enough or because they could not afford to pay (reasons 3 and 8 above), were left in the sample. All other respondents, in effect, reasoned that "something else should be done" and rejected the scenario presented in the question. These responses failed the "scenario rejection" check and their bids were excluded from the sample. For these individuals, a zero bid may be a reflection of their disapproval of the scenario presented in the CVM question and not an indicator of the value they place on forest quality. Remaining zero bids and positive bids were then tested against responses to other questions. These questions fall into two categories;

The first category asks if the commodity to be valued impacts the respondent's well being. This question can be framed in a yes/no or degree of impact manner. For example, question 4 of the recreator and question 3 of the property owners survey asked respondents what type of injury affects their enjoyment during a visit to the Angeles or San Bernardino National Forests. Respondents who replied that there was no effect on their enjoyment from injury were rejected from the sample if they answered positively to willingess to pay questions 22, 23, or 24 in the recreator survey and questions 35, 36, 37 and 38 of the property owners survey. Conversely, those who replied that their enjoyment was decreased greatly by injury yet who answered negatively to the willingness to pay questions, were removed from the sample. Because thresholds for bid rejection in the case of low or high impacts are arbitrary, investigators often use no impact or any impact as the respective criteria for rejection of positive or zero bids on the grounds of inconsistency.

The second category of consistency questions concerns actual or hypothetical actions in response to the symptom or commodity to be valued. For example, question 21 of the recreator survey asked respondents if a decrease in forest quality would change the number of trips they would make to areas in the Angeles and San Bernardino National Forests. Respondents who said they would make the same number of trips to the forests but their enjoyment would be less, or those who said they would make fewer trips to the forests had to have made a positive bid to willingness to pay question 22 in the recreator survey or they were rejected. In other words, only those who would make the same number of trips with no effect on their enjoyment were allowed to make a zero bid. This portion of the consistency check was only used in the recreator survey.

In summary, the consistency checks employed first removed zero bids resulting from the respondents rejection of the willingness to pay scenario. Then, remaining bids were checked against questions on impacts of well being and actions.

A final consistency check on the size of the respondents bid as a share of income had no effect on the results. In other words no bids could be rejected as being unreasonably large.

The results of the consistency checks for the recreator survey are shown in Tables 8-3 and 8-4. Table 8-3 shows mean recreator willingness to pay bids for the Angeles and San Bernardino National Forests after the "scenario rejection" check. Bids are divided by the respondent's county of residence. Table 8-4 compares recreator willingness to pay bids by county before and after the second set of consistency checks as described above were applied. Bids are further divided into user, existance and bequest components. These categories are derived from part B of the contingent valuation questions where respondents indicated what percentage of their bid was for 1) preserving the forests for their own use (USER), 2) preserving the forests even if no one uses them (EXISTANCE) and 3) preserving the forest for others (BEQUEST). Since the consistency checks employed focused on questions about the respondents personal visitation and use of the forests, they are relevant only to the USER portion of the bid and not the existance and bequest portions. (Note: mean statistics may vary by percentage points and may not be additive due to respondents who, when portioning their bids into the above three categories, apportioned some of their bid to the "other" category. These bids were not included in the data used in Table 8-3.)

Table 8-5 compares respondents incremental willingness to pay bids for the Angeles and San Bernardino National Forests from the property value survey. Like Table 8-4, bids are broken down into their user, existance and bequest components and data is presented before and after consistency checks.

TABLE 8-4

RECREATORS WTP FOR ANGELES AND SAN BERNARDINO NATIONAL FORESTS WITH SCENARIO REJECTION BEFORE AND AFTER CONSISTENCY CHECKS

		LOS ANGELES		SAN BERNARDINO		ORANGE	
		Before Checks	After Checks	Before Checks	After Checks	Before Checks	After Checks
USER	Mean	11.40	12.53	8.49	13.99	17.79	30.57
	Mean (>0)	21.31	15.23	11.82	11.82	15.10	16.42
	Zero Bids/ Sample Size	21/66	0/36	22/56	0/34	20/57	0/31
EXIST	Mean	31.45		20.17		22.71	-
	Mean (>O)	25.70		16.96		22.14	-
	Zero Bids/ Sample Size	6/66		10/56		11/57	-
BEQUEST	Mean	8.67		11.61	-	12.85	-
	Mean (>O)	16.81		10.2	-	15.39	-
	Zero Bids/ Sample Size	28/66		16/56		17/57	-

TABLE 8-5

PROPERTY OWNERS WTP FOR ANGELES AND SAN BERNARDINO NATIONAL FORESTS WITH SCENARIO REJECTION BEFORE AND AFTER CONSISTENCY CHECKS

		Before Checks	After Checks
USER	Mean	18.45	27.37
	Mean (>O)	23.59	23.59
	Zero Bids/ Sample Size	48/149	0/100
EXIST	Mean	43.44	
	Mean (>O)	30.95	
	Zero Bids/ Sample Size	12/149	
BEQUEST	Mean	15.86	
	Mean (>O)	19.19	
	Zero Bids/ Samples Size	42/149	

Frequency distributions of gross CVM bids from the recreator sample are presented in Figures 8-1 through 8-3. Gross CVM bids from the property value sample are shown in Figures 8-4 through 8-7. The distribution of bids is typical of those obtained in past CVM studies. The horizontal axis is logged, starting at $0 and increases in increments of $10'^{5}$. The vertical columns on each graph are defined to include all bids greater than the value of the left hand boundary of the horizontal axis and less than or equal to the right hand boundary.

In each of the figures the modal bid is at zero with a large number of bids falling between the $\$10^{1}$ and $\$10^{15}$ values. The large number of zero bids in our view consists of scenario rejections ("I should not have to pay, it's not my fault") and edits ("Forest injury is not an important enough factor in my decisionmaking for me to bother considering how valuable it is."). In real world decisionmaking edited attributes do not contribute to willingness to pay for actual commodities. Thus, it is our view that zero bids which result from editing should be included in measures of value used in benefit cost analysis. Scenario rejections should, of course, be excluded. Thus, for the damage calculations of the next section, only zeros associated with scenario rejection are deleted. It should be noted that both for recreators (Table 8-5) and for property owners (Table 8-6) no zero user bids survived the second set of consistency checks, consistent with the psychological model of editing. In other words, an edit zero implies that the value of tree quality falls below some threshold for the individual where valuation itself is not worth considering in the decision process. These individuals, even though they "like" tree quality are not affected by it in their recreation or home purchase decision.

A second check on the validity of contingent values is also proposed by Gerking, McClelland, Schulze and Dickie (1987). Based on the experimental work of McClelland, Schulze and Coursey (1987), they argue that positive values are almost always formed from a top down anchoring and adjustment process. In other words people, when attempting to determine if something is actually worth purchasing think first about the worth to them of the broad set of activities into which the commodity fits. In dollar terms this worth has been called a “mental account.” This mental account forms an anchor from which people adjust down to come up with the portion of the mental account which comprises the value of items which might be purchased. Unfortunately psychologists have demonstrated that this downward adjustment almost always initially falls short of the target or "true" value. Decisionmaking experience seems to improve the adjustment process. Thus, inexperienced positive values will tend to overestimate true values. The frequency distribution of the logarithm of inexperienced values tends to show a very thick upper tail in laboratory experiments where people form real values for the first time. As people gain more experience (as many as 100 trials are used in these experiments) mean positive values fall and the frequency distribution becomes log normal (see McClelland, Schulze and Coursey, 1987). The frequency distributions presented in Figures 8-l to 8-7 do not show the thick upper‘ tails indicative of immature values which show insufficient adjustment. This suggests that positive bidders have had sufficient past experience in valuing tree quality to provide credible values.

FIGURE 8-1

RECREATOR SURVEY - FREQUENCY DISTRIBUTIONS OF LOGGED GROSS WTP BIDS FOR ANGELES AND SAN BERNARDINO NATIONAL FORESTS

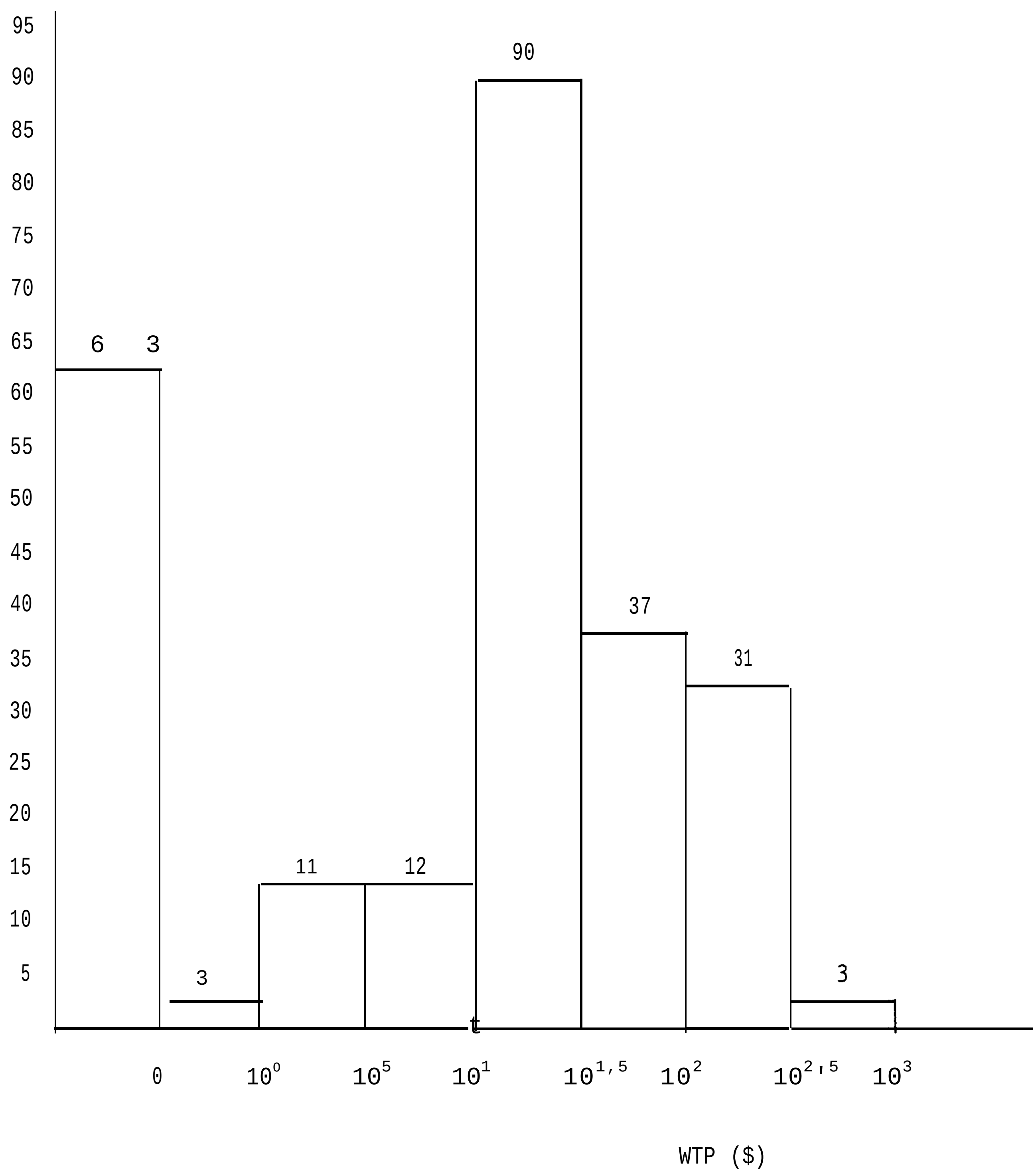


FIGURE 8-2

RECREATOR SURVEY - FREQUENCY DISTRIBUTION OF LOGGED GROSS WTP BIDS FOR CALIFORNIA FORESTS

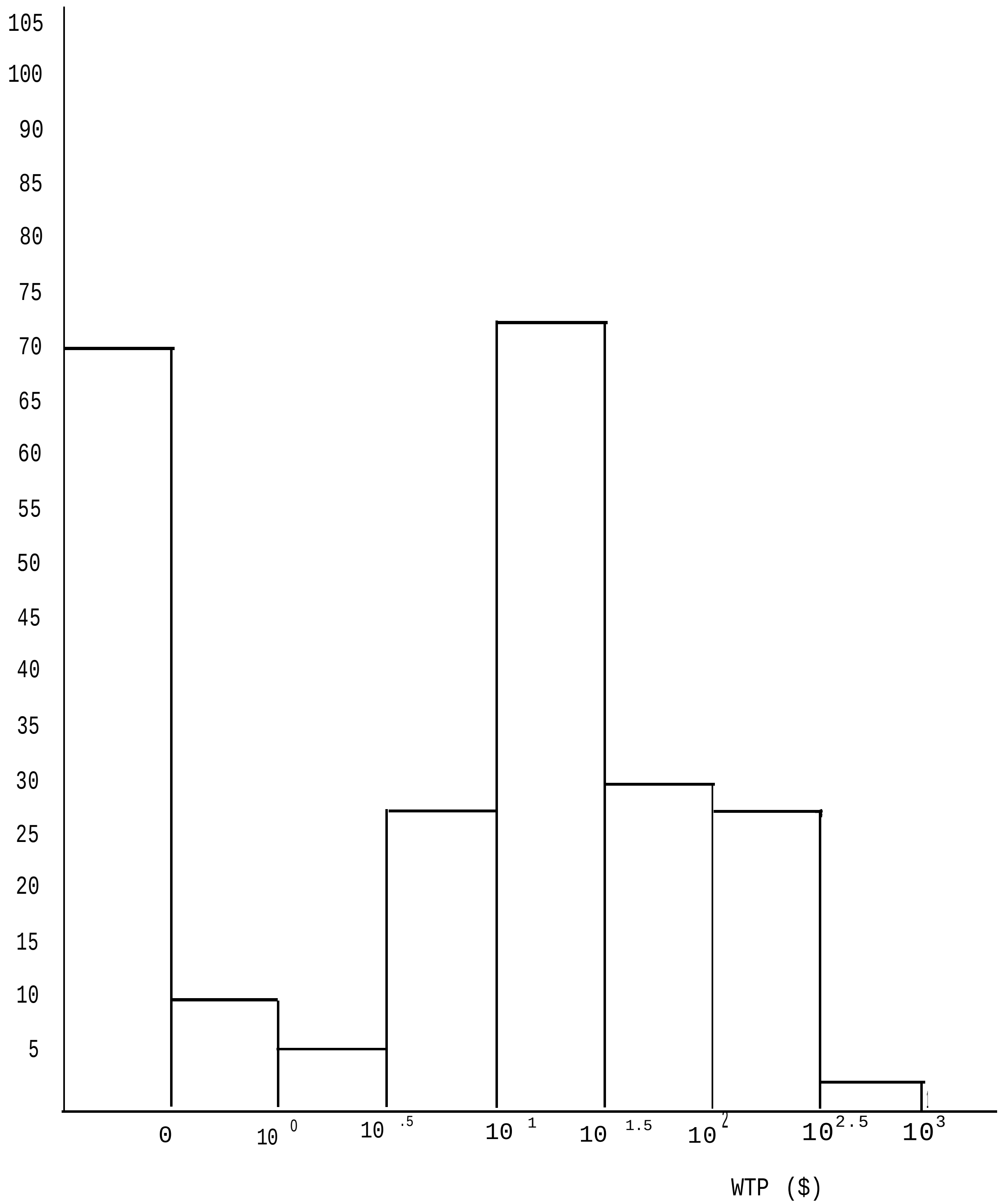


FIGURE 8-3

RECREATOR SURVEY - FREQUENCY DISTRIBUTION OF LOGGED GROSS WTP BIDS FOR ALL U.S. FORESTS

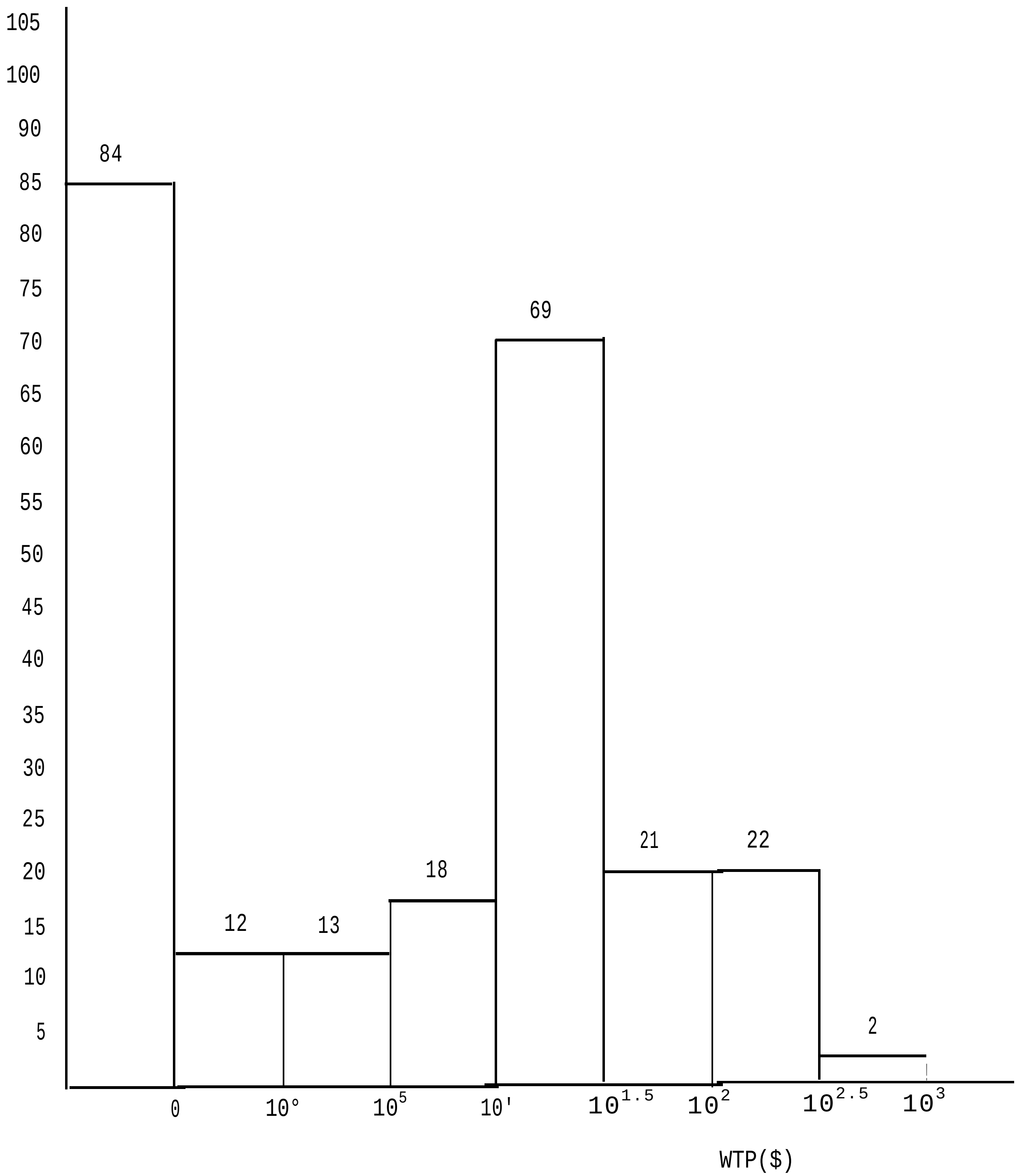


FIGURE 8-4
PROPERTY SURVEY - FREQUENCY DISTRIBUTION OF LOGGED GROSS WTP BIDS FOR AREA AROUND RESIDENCE

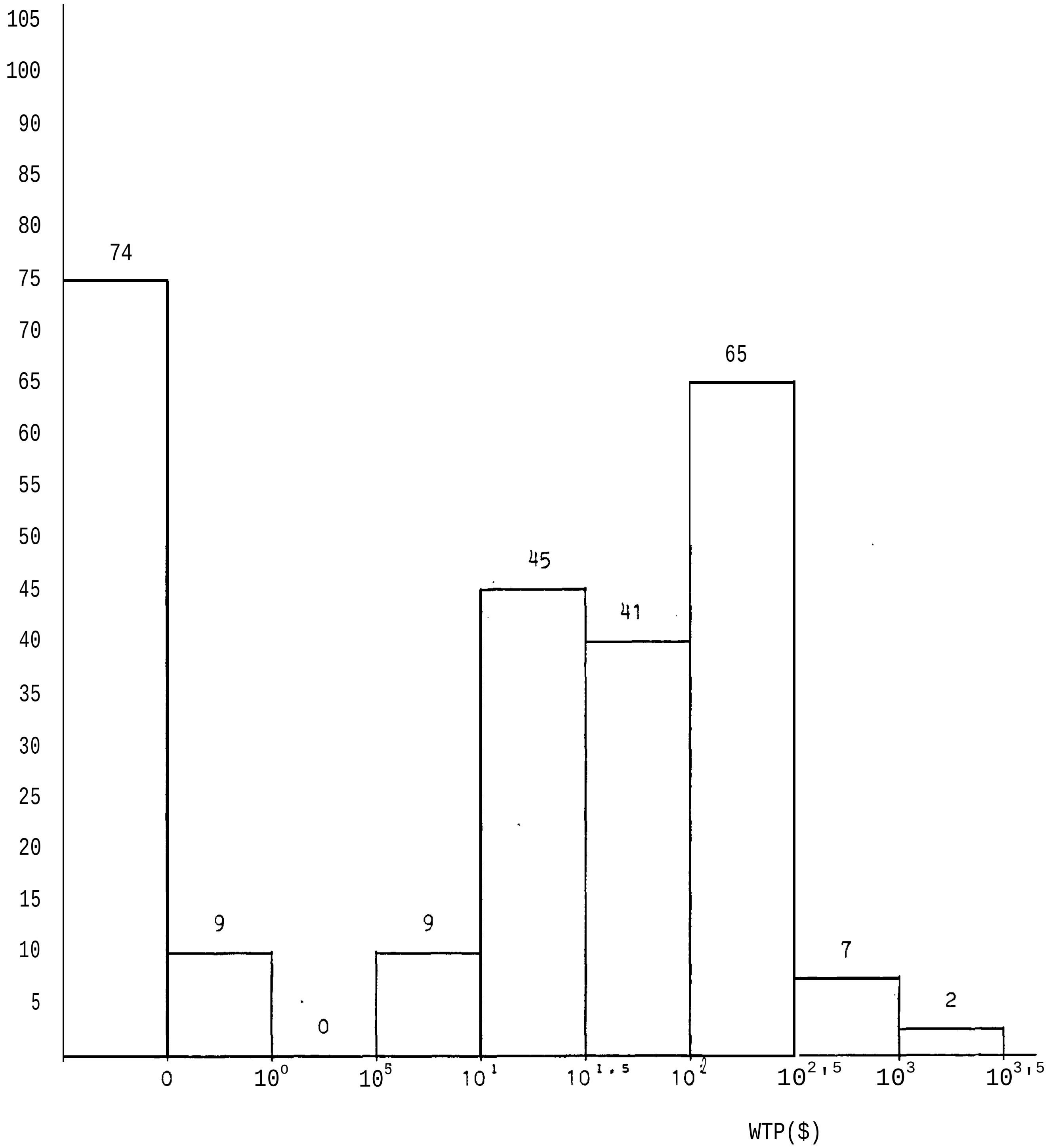


FIGURE 8-5

PROPERTY SURVEY - FREQUENCY DISTRIBUTIONS OF LOGGED GROSS WTP BIDS FOR ANGELES AND SAN BERNARDINO NATIONAL FORESTS

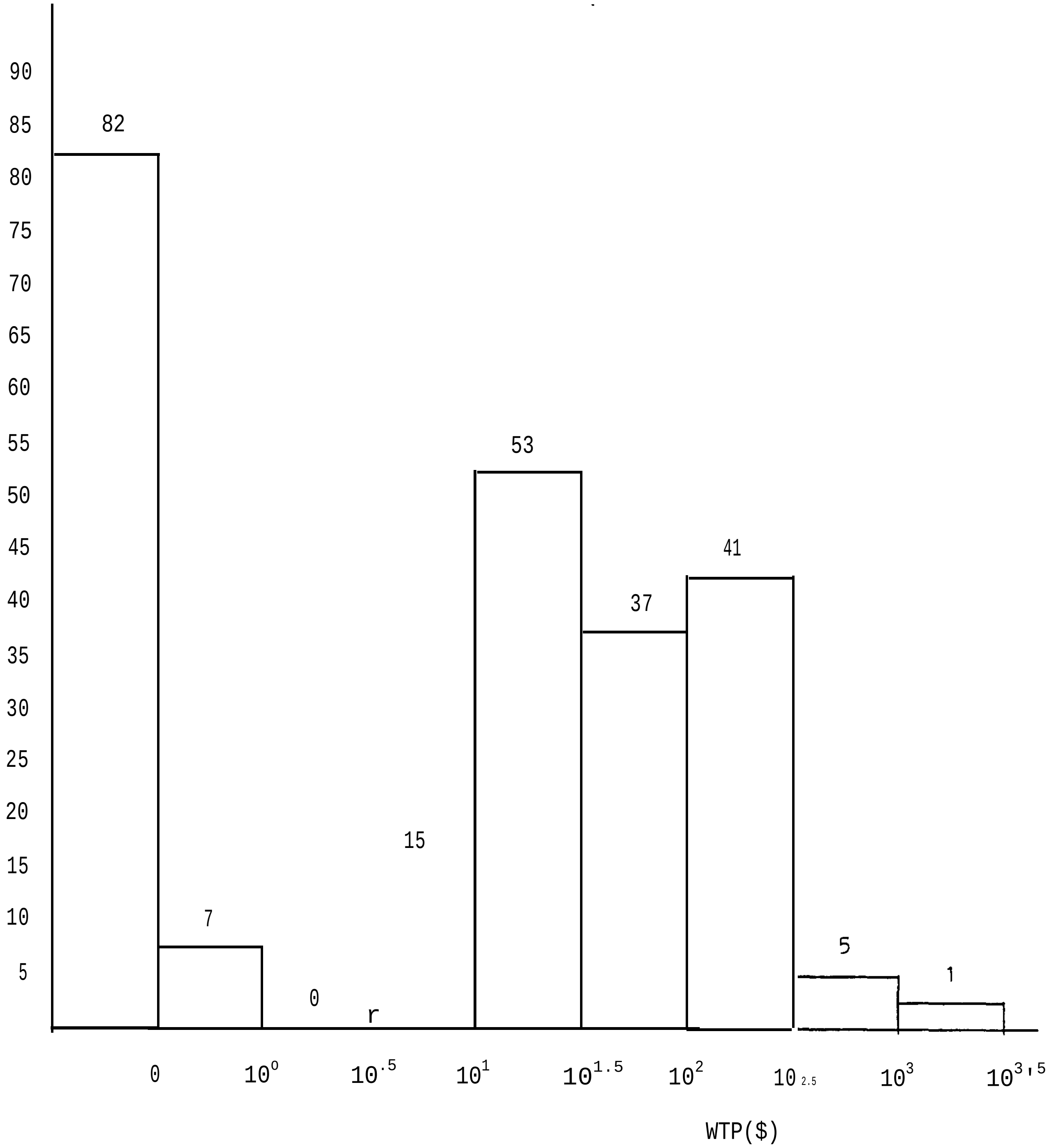


FIGURE 8-6

PROPERTY SURVEY - FREQUENCY DISTRIBUTION OF LOGGED GROSS WTP BIDS FOR CALIFORNIA FORESTS

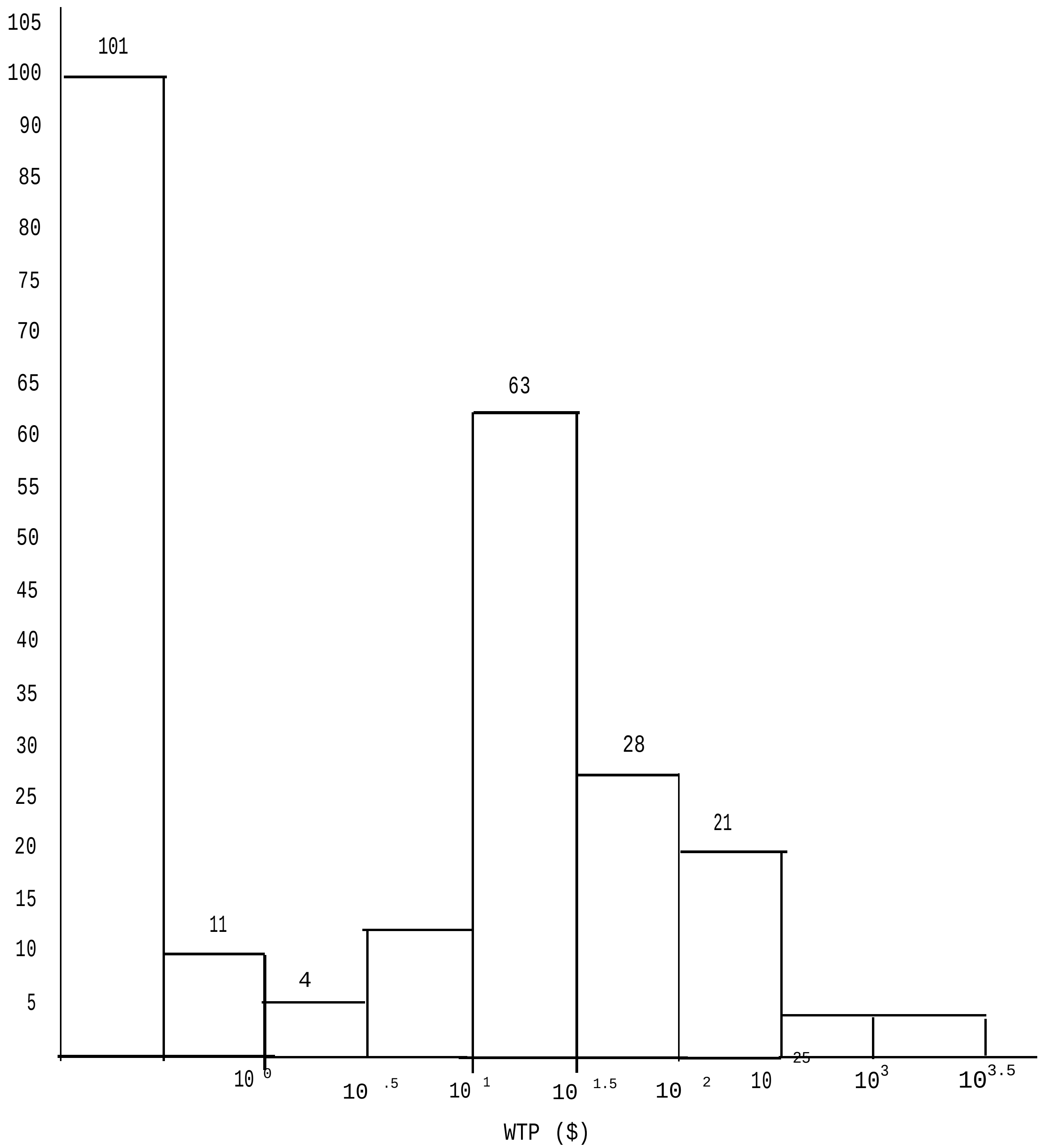
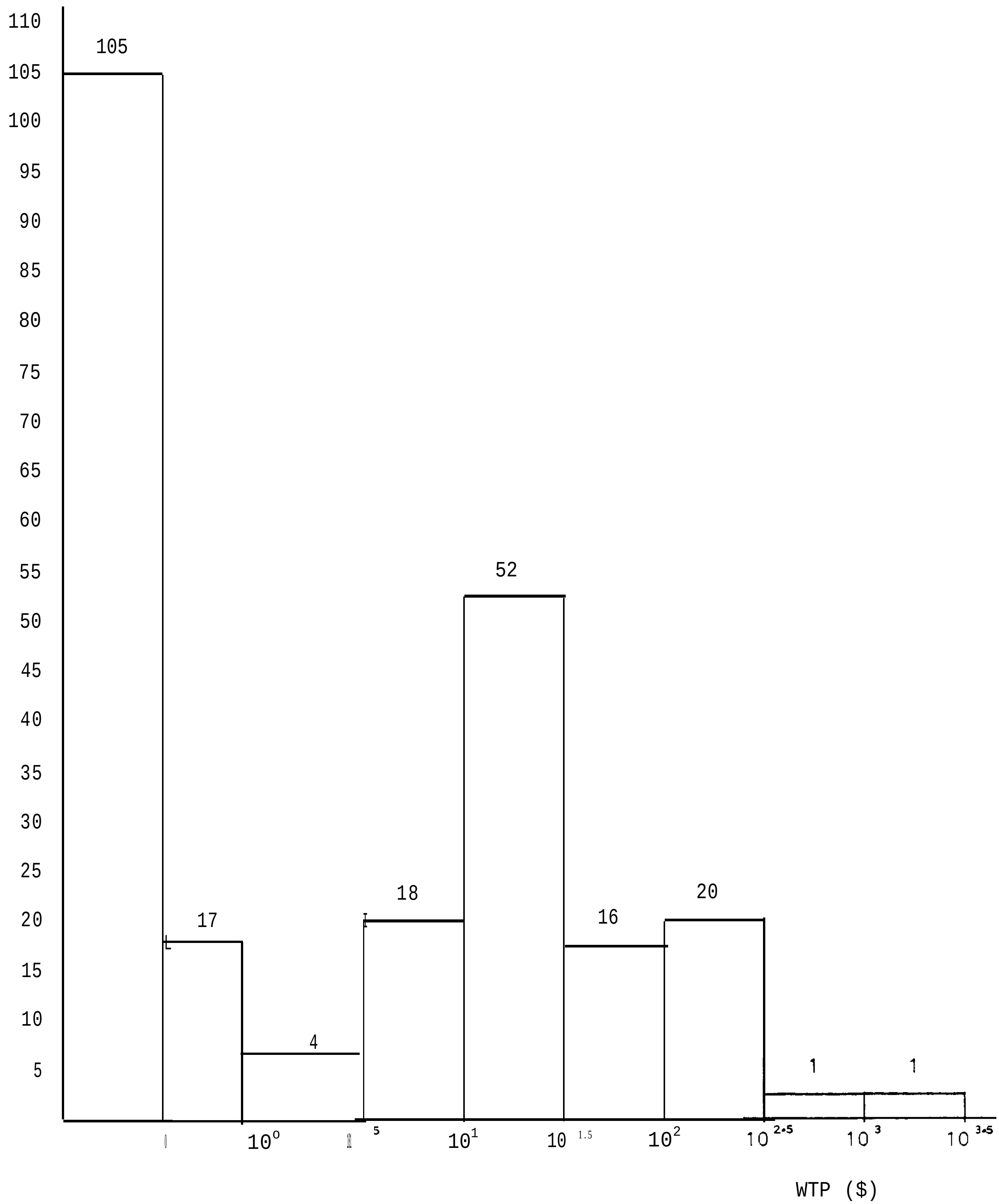


FIGURE 8-7

PROPERTY SURVEY - FREQUENCY DISTRIBUTION OF LOGGED GROSS WTP BIDS FOR ALL U.S. FORESTS



8.2 Damage Calculations For the Angeles and San Bernardino, National Forests

The method used to approximate the aesthetic tree damage to the residents of Los Angeles, Orange, and San Bernardino Counties from ozone air pollution employs four steps. First, an estimate is made as to how much visible injury from all sources (including insects and disease) is apparent to visitors to the Angeles and San Bernardino National Forests. This estimate was generated from the perception of tree quality of rereators in each forest region. To obtain an overall estimate of the perceived loss in tree quality to the forests, these regional losses were weighted by visitation to each region. Second, these losses were adjusted for a high and low estimate of the portion of visible tree damage in each region attributable to ozone. Third, user, existance and bequest values for a one unit reduction in perceived tree quality (by county) were multiplied by the visitation weighted loss in tree quality due to ozone. Fourth, these estimates were multiplied by the number of households in each county and totaled.

Table 8-6 shows the numbers used in the construction of the visitation weighted quality loss figure, which was the first step in the calculation of damages due to ozone. First the number of visits to each region was taken from the survey, and divided by the total number of visits to all the regions, also from the survey. This then gave the fraction of total visits to each region (column 2 in Table 8-6). Next the loss in tree quality within each region was determined. This was done by taking the mean tree quality estimates for each region (see chapter 6), and subtracting them from 5. This difference is the tree quality loss within each region from the best possible tree quality ranking.

TABLE 8-6

Calculation of Visitation Weighted Quality Loss Due to Ozone (0,)

Region	Fraction of Visitors to Region	Quality Loss in Region	Traction of Damages Attributed to Ozone High	(Low)	Visitation Weighted Quality Loss Due to Ozone High	(Low)
1	.036	2.37	.30	(.10)	.026	(.009)
2	.058	2.03	.50	(.30)	.059	(.035)
3	.070	1.52	.30	(.10)	.032	(.011)
4	.020	1.93	.50	(.30)	.019	(.017)
5	.029	2.29	.50	(.20)	.033	(.013)
6	.038	2.10	.30	(.10)	.023	(.008)
7	.178	1.70	.60	(.20)	.182	(.061)
8	.247	1.58	.60	(.20)	.234	(.078)
9	.189	1.29	.20	(.07)	.049	(.017)
10	.135	1.41	.40	(.05)	.076	(.010)
Total	1.00				.733	(.259)

The third column then gives high and low estimates for the percent of tree damage caused by ozone. These are subjective estimates made for each region based on visible damage caused by ozone. The factors discussed in Chapter 3 such as susceptibility of tree species to ozone damage, drought, local ozone concentrations, etc. were taken into account in making these subjective assessments. The fraction of vistors to the region, the tree quality loss in the region, and the subjective fraction of tree damage due to ozone were then multiplied together within each region. This yielded two numbers for each region corresponding to the high and low ozone damage estimates for the visitation weighted quality loss due to ozone. The high and low estimates were each summed across all ten regions to give an area wide visitation weighted quality loss due to ozone. These numbers are reported at the bottom of the last column in Table 8-6, and are respectively .733 and .259 for the high and low estimates of ozone damage.

The next step was to make the actual damage calculations. This was first done for each county. The calculation employed the mean use, existance, and bequest CVM values for a one step change in tree quality for the forests (see Table 8-4). These mean values were each then multiplied by the number of households in each county. This number was determined by taking the estimated population of each county, used in chapter 5, and dividing it by the average household size reported in the survey results (see chapter 6). These estimates of the number of households can be found in column 3 of tables 8-7 through 8-9.

The product of the number of households, and CVM bids was then multiplied by the visitation weighted quality loss figures, both high and low, determined above. These values provide the high and low estimates for the willingness to pay to avoid the decrease in forest quality attributable to ozone. The user, existance, and bequest damage calulations were then summed within each county to get a county damage calculation which is shown in the last row of Tables 8-7 through 8-9. As can be seen, Los Angeles County had total damages, on the high end, Of $110,514,510, and on the low end of $39,049,465 (Table 8-7). The high and low estimates for San Bernardino were $11,800,345, and 4,169,563 repectively (Table 8-8). While the Orange County high and low figures were $31,863,866, and $11,258,856 respectively (Table 8-9).

Table 8-10 summarizes the results for each county by CVM bid catagory, and total. The final row is the sum of each county's user, existance, bequest, and total ozone related damages. This then gives a figure of $154,178,721 for high estimate of ozone related tree damage per year, and $54,477,884 per year for the low estimate of damage for the three county study area. These estimates should be adjusted downward for non-response bias as reported in Chapters 5 and 6.

The damage estimates above were calculated on the assumption that the survey responses represented a random sample of households in the study area. This may not be a reasonable assumption given that the adjusted response rate for the survey was 49.5%. In the worst possible case we could assume that all people who did not respond would have had a willingness to pay of zero. In this case we would want to adjust the damage estimates to reflect these values. An adjustment was made by multiplying both the high and low total damage by .495 which represents the fraction of people within the study area who responded or were able to respond to the survey. These numbers, $76,318,467 for high perceived ozone

TABLE 8-7
Recreator
Los Angeles County Damages Calculation

	One Step Bid	Average Number Households	Visitation Weighted Quality Loss due to O_3 High/(Low)	Total Damage in dollars High/(Low)
User	11.40	2,926,439	0.733 (0.259)	24,453,909 (8,640,604)
Existance	31.45	2,926,439	0.733 (0.259)	67,462,759 (23,837,455)
Bequest	8.67	2,926,439	0.733 (0.259)	18,597,842 (6,571,407)
Total	51.52	2,926,439	0.733 (0.259)	110,514,510 (39,049,465)

TABLE 8-8
Recreator
San Bernardino County Damages Calculation

	One Step Bid	Average Number Households	Visitation Weighted Quality Loss due to O_3 High/(Low)	Total Damage in dollars High/(Low)
User	8.49	399,769	0.733 (0.259)	2,487,830 (879,056)
Existance	20.17	399,769	0.733 (0.259)	5,910,428 (2,088,405)
Bequest	11.61	399,769	0.733 (0.259)	3,402,086 (1,202,101)
Total	40.27	399,769	0.733 (0.259)	11,800,345 (4,169,563)

TABLE 8-9
Recreator
Orange County Damages Calculation

	One Step Bid	Average Number Households	Visitation Weighted quality Loss due to O_3 High/(Low)	Total Damage in dollars High/(Low)
User	17.79	814,817	0.733 (0.259)	10,625,270 (3,745,359)
Existance	22.71	814,817	0.733 (0.259)	13,563,794 (3,754,359)
Bequest	12.85	814,817	0.733 (0.259)	7,674,802 (2,711,833)
Total	53.35	814,817	0.733 (0.259)	31,863,866 (11,258,856)

TABLE 8-10
Unadjusted Total Ozone Related Damages to
San Bernardino and Los Angeles National Forest
High/(Low)

County	User	Existance	Bequest	Total
Los Angeles	24,453,909 (8,640,604)	67,462,759 (23,837,455)	18,597,842 (6,571,407)	110,514,510 (39,049,465)
Orange	10,625,270 (3,745,359)	13,563,794 (3,754,359)	7,674,802 (2,711,833)	31,863,866 (11,258,856)
San Bernardino	2,487,830 (897,056)	5,910,428 (2,088,405)	3,402,086 (1,202,101)	11,800,345 (4,169,563)
Grand Total	37,566,909 (13,274,019)	86,936,981 (29,680,219)	29,674,730 (10,485,341)	154,178,721 (54,477,884)

damage, and $26,966,522 for the low ozone estimate are reported in the third column of Table 8-11 under "LOW ESTIMATE".

The telephone survey conducted to examine non-response bias shows, however, that such a large reduction is probably not correct. That survey showed that 78% of the people contacted by phone had, in fact, visited either the San Bernardino, or Angeles National Forests. This compares to a 90% visitation rate for the mail survey. The ratio of these two numbers was then used to estimate that non-respondents visited the forests about 86.7% as frequently as respondents to the mail survey. We assume, to adjust for this bias, that non-respondents willingness to pay would be about 86.7% of respondents willingness to pay. These adjusted estimates are reported in column 2 of Table 8-11, and are $143,848,747 and $50,827,866 repectively for the high and low ozone estimates. These estimates are about 7% less than the totals in table 8-10. This then gives us a range of damages across both the high and low perceived ozone damage estimate and for a high and low estimate for non-response bias.

TABLE 8.11

TOTAL OZONE DAMAGE TO SAN BERNARDINO AND ANGELES NATIONAL FOREST
ADJUSTED FOR NON-RESPONSE BIAS

(24.3% use value, 56.3% existance value, 19.4% bequest value)

	High Estimate for Non-Response Bias	Low Estimate for Non-Respone Bias
Adjusted Total Damage in Dollars High Ozone	$143,848,747	$76,318,467
Adjusted Total Damage in Dollars Low Ozone	$50,827,866	$26,966,552

CHAPTER 8 - REFERENCES

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Rowe, R., W. Schulze, B. Hurd, and D. Orr. Economic Assessment of Damage Related to the Eagle Mine Facility, Report to the Colorado Department of Law, Energy and Resource Consultants, Boulder, CO (1986a).

Rowe, R., W. Schulze and B. Hurd, A Survey of Colorado Residents' Attitudes About Cleaning Up Hazardous Waste-Site Problems in Colorado, Report to the Colorado Department of Law, Energy and Resource Consultants, Boulder, CO (1986b).